

# CS59300-SER: Software Engineering for Robotics

## Spring 2025

### Course Information

Course Number	CS59300-SER
Meeting Time	TBD
Course Room	TBD
Course Credits	3.0
Instruction Modality	Face-to-Face

### Instructor Contact Information

Instructor	Zachary Kingston, Assistant Professor of Computer Science
Instructor Email	<a href="mailto:zkingston@purdue.edu">zkingston@purdue.edu</a>
Instructor Office	TBD
Office Hours	TBD and by appointment

I am available via email and will try to respond as soon as I can (usually with 24-48 hours, might be longer on weekends). When emailing me, please put the course number in the subject line of the email (e.g., “[CS59300-SER] Help with assignment”) to make sure I see it.

### Course Description

Developing software for robot systems is challenging as they must sense, actuate, and represent the physical world. Sensing the physical world is usually noisy, actuating in and on the world is often inaccurate, and the knowledge and representation of the world is incomplete and uncertain. In this class we will explore software engineering approaches to cope with those challenges. You will learn to use domain-specific abstractions, architectures, libraries, and validation approaches and tools to safely perform robot activities like motion, navigation, perception, planning, and interaction. Moreover, you will learn more about performance engineering and modern hardware acceleration to take algorithms to the next level necessary for real-time robotic performance. The expectation is that this course will open up new career options in robotics for students.

### Learning Outcomes

After successfully completing this course, a student should be able to:

1. Use and deploy a robot system using a Linux-based operating system using the Robot Operating System (ROS) middleware.
2. Understand and design a robot system, and be able to weigh the trade-offs that go into system design.
3. Understand and implement basic robotics algorithms for a mobile system.
4. Diagnose and improve performance bottlenecks in a robotic system.

### Prerequisites

1. Background in linear algebra (MA 26500 Linear Algebra)
2. Algorithms or Systems programming (CS 25100 or CS 25200)

## Learning Resources, Technology and Texts

There is no required textbook for this course. Lecture notes, research papers, and online resources will be provided throughout the course. For the interested reader, there are recommended textbooks that cover much of the basic background necessary:

1. [A Gentle Introduction to ROS by Jason M. O’Kane](#)
2. [Planning Algorithms by Steven M. LaValle](#)
3. [Modern Robotics by Kevin M. Lynch and Frank C. Park](#)
4. [Robotic Systems by Kris Hauser](#)
5. [Robotic Manipulation: Perception, Planning, and Control by Russ Tedrake](#)

## (Tentative) Course Topics

1. Introduction and Basic Robotics
2. Software Tools
3. Distributed Systems and Networking
4. Sensor Models and Abstractions for Perception
5. Robot Control and Hardware Abstraction
6. Trade-offs in Planning
7. Localization and Mapping
8. Transformations and Scene Understanding
9. Specifying and Generalizing Systems
10. Performance Engineering

## Assessment and Grading

In-Class Labs	70% (10% each)
Course Project	20%
Participation and In-Class Activities	10%

Regrade requests can only be made within one week of the submission deadline.

## Missed or Late Work

Late submissions will be penalized by a 20% reduction in grade for each day late. Missed assignments may only be made up when you notify me ahead of time with an explanation and plan for completion. These requests will be accepted at my discretion. Asking for an extension does not guarantee it will be granted.

## Attendance Policy

Students are expected to be present for every meeting of the class. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible. For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, the student or the student's representative should contact the Office of the Dean of Students via email or phone at [765-494-1747](tel:765-494-1747).

## Academic Integrity

Academic integrity is one of the highest values that Purdue University holds. Individuals are encouraged to alert university officials to potential breaches of this value by either emailing [integrity@purdue.edu](mailto:integrity@purdue.edu) or by calling [765-494-8778](tel:765-494-8778). While information may be submitted anonymously, the more information that is submitted provides the greatest opportunity for the university to investigate the concern. Please also refer to Purdue's student guide for academic integrity. The Purdue Honor Pledge states: "As a boilermaker pursuing academic excellence, I pledge to be honest and true in all that I do. Accountable together—we are Purdue."

## Use of Artificial Intelligence (AI) or Large Language Models (LLMs) in this Course

Students are permitted to use generative AI tools (e.g., ChatGPT) for any class assignments. If such tool was used in any part of the assignment completion, students are expected to state how the tool was used in detail in the submitted work.

## Accessibility and Accommodations

Purdue University strives to make learning experiences as accessible as possible. If you anticipate or experience physical or academic barriers based on disability, you are welcome to let me know so that we can discuss options. You are also encouraged to contact the Disability Resource Center at: [drc@purdue.edu](mailto:drc@purdue.edu) or by phone: [765-494-1247](tel:765-494-1247).

## Nondiscrimination Statement

Purdue University is committed to maintaining a community, which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life. Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, genetic information, marital status, parental status, sexual orientation, gender identity and expression, disability, or status as a veteran. The University will conduct its programs, services, and activities consistent with applicable federal, state, and local laws, regulations, and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies. Any student who believes they have been discriminated against may visit the University's website to submit a complaint to the Office of Institutional Equity. Information may be reported anonymously.

## Emergency Preparation

In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor's control. Relevant changes to this course will be posted on the course website or can be obtained by contacting the instructor via email. You are expected to read your [@purdue.edu](mailto:yourname@purdue.edu) email on a frequent basis.

## Mental Health Statement

If you are struggling and need mental health services: Purdue University is committed to advancing the mental health and well-being of its students. If you or someone you know is feeling overwhelmed, depressed, and/or in need of mental health support, services are available. For help, such individuals should contact [Counseling and Psychological Services \(CAPS\)](#) at 765-494-6995 during and after hours, on weekends and holidays, or by going to the CAPS office on the second floor of the Purdue University Student Health Center (PUSH) during business hours.

## Basic Needs Security

Any student who faces challenges securing their food or housing and believes this may affect their performance in the course is urged to contact the Dean of Students for support. There is no appointment needed and Student Support Services is available to serve students 8 a.m.–5 p.m. Monday through Friday.

## Disclaimer

This syllabus is subject to change, and students will be notified accordingly of any changes.

## Acknowledgements

This course is directly inspired by and adapted from [Sebastian Elbaum](#). Parts of this syllabus were adapted and inspired by syllabi from Ming Yin at Purdue, Sabrina Neuman at Boston University, and the [Purdue Syllabus Guidelines](#).